THE CLAIMS

1. A chemical reactor comprising:

a) a core composed of at least one stack of metal plates bonded in face-to-face relationship,

b) a plurality of reaction zones located within the core,

c) a plurality of catalyst receiving zones located within the core,

d) a first channel arrangement provided in at least some of the plates for transporting a first reactant to and between the reaction zones, portions of the first channel arrangement that interconnect the reaction zones being formed over at least a portion of their length as heat exchange channels,

e) a second channel arrangement provided in at least some of the plates and arranged to deliver a second reactant to each of the reaction zones, and

f) a third channel arrangement provided in at least some of the plates for transporting a third reactant to and between the catalyst receiving zones, portions of the third channel arrangement that interconnect the catalyst receiving zones being formed over at least a portion of their length as heat exchange channels that are positioned in heat exchange proximity to the heat exchange channels of the first channel arrangement.

2. The chemical reactor as claimed in claim 1 wherein the core comprises a single stack of metal plates which are diffusion bonded in face-to-face contacting relationship.

3. The chemical reactor as claimed in claim 2 wherein each of the reaction zones is defined by aligned apertures in adjacent plates of the stack.

4. The chemical reactor as claimed in claim 2 wherein each of the catalyst receiving zones is defined by aligned apertures in adjacent plates of the stack.

5. The chemical reactor as claimed in any one of claims 2 to 4 wherein the reaction zones are arranged to constitute combustion zones.

6. The chemical reactor as claimed in any one of claims 2 to 5 wherein the reaction zones are charged with a catalyst that is selected to provide for catalytic combustion of the first and second reactants.

7. The chemical reactor as claimed in any one of claims 2 to 6 wherein the plates are stacked in repeating groups of six superimposed plates, with the first and fourth plates (in descending order) being formed with the first channel arrangement for transporting the first reactant to and between the reaction zones, the second and fifth plates being formed with the second channel arrangement for delivering the second reactant to the reaction zones and the third and sixth plates being formed with the third channel arrangement for transporting the third reactant to and between the catalyst receiving zones.

8. The chemical reactor as claimed in claim 7 wherein the second and fifth plates have a thickness that is less than that of the other plates in each group.

9. The chemical reactor as claimed in claim 7 or claim 8 wherein channel elements that form the second channel arrangement have a cross-sectional area that is smaller

than that of channel elements that form the first and third channel arrangements.

10. The chemical reactor as claimed in any one of the preceding claims wherein the reaction zones are arrayed in two parallel rows and the first channel arrangement extends linearly between the reaction zones.

11. The chemical reactor as claimed in claim 10 wherein the catalyst receiving zones are arrayed in three parallel rows, one of which is located between the rows of reaction zones and the other two of which are located outside of the rows of reaction zones.

12. The chemical reactor as claimed in any one of the preceding claims when in the form of a reformer that is suitable for use in association with a fuel cell.

13. The chemical reactor as claimed in any one of claims 2 to 12 when embodied in a fuel processor having a reformer stage that incorporates the reaction zones, when in the form of conduction zones, and the catalyst receiving zones.

14. The chemical reactor as claimed in any one of claims 2 to 12 when embodied in a fuel processor for use in association with a proton exchange membrane fuel cell, the fuel processor having a reformer stage that incorporates the reaction zones, when in the form of conduction zones, and the catalyst receiving zones.

15. The chemical reactor as claimed in claim 13 or claim 14 wherein the fuel processor, of which the reactor forms

a part, incorporates at least one pre-reformer stage incorporating at least one of the catalyst receiving zones.

16. The chemical reactor as claimed in claim 15 wherein the fuel processor incorporates at least one pre-reformer that is arranged to be heated by a hot syngas.

17. The chemical reactor as claimed in claim 15 or claim 16 wherein the fuel processor incorporates at least one pre-reformer that is arranged to be heated by hot flue gas that is, in use, directed through a portion of the third channel arrangement.

18. A method of effecting a chemical reaction in a chemical reactor as claimed in any one of the preceding claims and which comprises the steps of:

a) directing a first reactant into and serially through the reaction zones in the chemical reactor by way of the first channel arrangement,

b) directing a second reactant in parallel feeds into the reaction zones by way of the second channel arrangement, the second reactant being selected to react exothermically with the first reactant in the respective reaction zones, and

c) concurrently directing a third reactant into and serially through a catalyst contained in the catalyst receiving zones by way of the third channel arrangement and, in so doing, exposing the reactant to heat from the product of the exothermic reaction in its passage through the heat exchange channels of the first channel arrangement.